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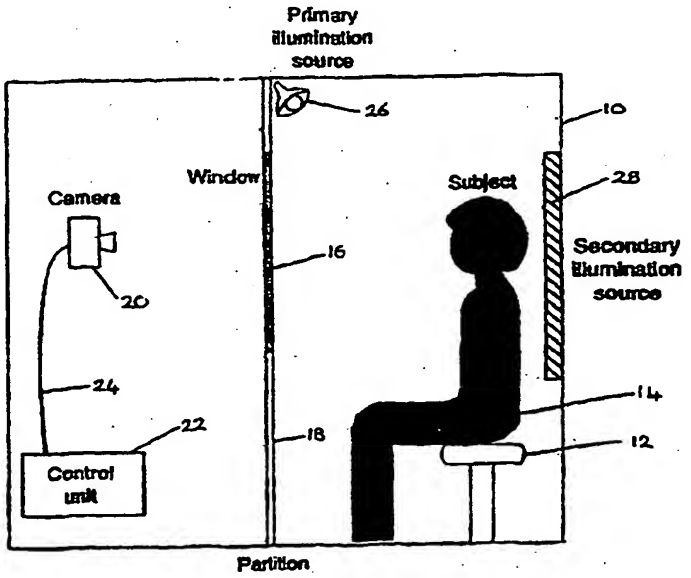
(54) Title: BACKGROUND SEPARATION FOR STILL AND MOVING IMAGES

(57) Abstract

A method and apparatus is described in which by differential illumination, two separate picture signals can be obtained of a subject in front of a background one of which corresponds to a silhouette of the subject and a gating signal is derived from the silhouette size and the other a normal picture signal of the subject and the background. By using the gating signal, signal content of the subject from the background signal content in the said other picture signal, so the background can be sublimated relative to the subject for example by substituting for a "busy background" a plain neutral background which contains no shadow. Differential illumination is achieved using visible light followed by infrared light or vice versa or by illuminating the subject and background from the front for one scan and back illuminating the subject during the other scan, to produce the silhouette signal by illuminating the subject and the background by an intense source of illumination so that the subject appears very bright against a less bright background. By synchronously switching the video signal which contains image content relating to both subject and background, the latter can be removed from the subject image content so the latter can be superimposed onto a different background. A second secondary image may be produced using side or top illumination to cast a shadow adjacent a particular feature. Image analysis may be used to detect the position of the shadow to enable the feature position to be determined. The technique is of particular application to the automatic production of passport photographs.



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Title: Background Separation for Still and Moving Images

Field of the invention

This invention concerns image enhancement techniques and apparatus therefor, particularly those employing bit map/ pixel digitisation.

Background to the invention

The image capture and ehnhancement field has traditionally been dominated by direct photographic techniques in which a subject is imaged directly onto a photographic medium to produce a latent image. The development of video technology has enabld the growth of electronic imaging, where the image is recorded as a time-varying electronic signal. More recently, the demand for 'special effects' and improved image quality, combined with the development of computer technologies and CCD camera systems has driven a rapid growth in digital imaging. Here the electronic signal is stored in digital form in a computer memory, allowing the data to be processed and the image enhanced.

Most of the demand for special effects has been from the entertainment industry, in particular for large-budget movies. On the other hand, digital image quality enhancement has been driven by the advertising and publishing industries.

There is now a growing demand for similar image processing

techniques from other areas of the photographic and imaging industries, including home photography, security imaging and photobooths. Two key requirements which are emerging in these fields are:

(1) To separate the subject, or foreground image, from the background in the captured image. This will allow both elimination of the background and its replacement by another image. Further image components can be added to the 'composite image', building up a complete, realistic picture of the original subject apparently in a different environment.

(2) To detect and locate significant features of the subject within the captured image. This ability is particularly important in preparing passport photographs where the size of the head in the final picture is specified by the authorities. Currently, many photobooths produce four copies of the same image at different magnifications in the hope that one of the images will meet the required specification.

Prior Art

The most common technique for background separation for both still and moving images is to ensure that the background is a substantially different colour from the foreground image. Then, on a pixel-by-pixel basis, the background can be eliminated or replaced in the captured image by selecting and removing those pixels which are close to the background colour and replacing them with pixels from a "different" background on a point for point correspondence basis. An alternative method is to determine the effective transparency of each pixel in the

captured image by measuring the deviation from the background colour. The captured image can then be merged with a background image, weighting the two images by the measured transparency so that very transparent pixels become dominated by the background image while opaque pixels are weighted in favour of the captured image.

The chief drawback of these techniques is that the background colour must not appear in the "subject". Thus if the background is blue, the subject must not contain any areas of similar hue.

It is an object of the present invention to provide a method and apparatus for distinguishing between the subject (foreground) and background of an image, and for detecting and locating significant features of the subject (foreground) image.

Summary of the Invention

According to one aspect of the present invention a method of generating digital pixel data of a field of view containing foreground and background content so that the former can be separated from the latter comprises:-

1. Scanning the field of view whilst subjecting the latter to normal illumination and storing the digitised data on a pixel by pixel basis relating as a first picture signal;

2. illuminating the field so as to render the foreground distinguishable from the background and scanning the field of view and storing the digitised signal so obtained on a pixel by pixel basis as a second picture signal;

3. generating the binary gating signal from the digitised video signal wherein the pixels in the gating signal have one value if they relate to the foreground and a second value if they relate to the background, and

4. processing the first picture signal using the binary gating signal so as to select the digital signals corresponding to the pixels which relate to the foreground content of the field of view from those relating to the background, to form a third picture signal.

By using this approach the digitised signal relating to the foreground can be separated from the digitised signal relating to the background and can then be merged with a digital signal corresponding to another background which may for example be plain or represent a different scene so that the separated foreground image content can be superimposed on a different background.

The scanning to produce the gating signal can be performed either before or after the normal scan.

Preferably both scans are undertaken in rapid succession so that any movement in the original field of view is effectively arrested so that the image data obtained by the two scans remains substantially aligned.

The illumination employed of is typically ordinary incandescent light or daylight or a flash lamp source. The illumination for the other scanning to produce the gating signal may be similar but more preferably is infrared. Both may be pulsed or modulated in some way.

The image content of the foreground must be readily distinguishable from the image content of the background in the scan producing the second picture signal. Infrared sources are particularly preferred since the infrared radiation is invisible to the subject particularly where the latter is human.

Where the illumination for producing the gating signal is to be pulsed, a shutter may be incorporated with the scanning camera and the operation of a shutter may be synchronised to the duration of the flash so as to reduce the effect of ambient light in the production of the gating signal.

In a photobooth or studio situation, the background may comprise an illuminated diffusive panel in fornt of which the subject is placed, so that image captured during the scanning to produce a second picture signal is a direct measure of the transparency of the foreground subject, and in the case of a generally opaque subject corresponds to a silhouette of the subject.

An advantage of the invention is that the restriction on the range of hues colours and the like otherwise imposed on the foreground subject is lifted completely since the transparency is now measured directly without the use of a reserved parameter such as colour or hue.

Since the scanning to produce the gating signal will still produce digital information which varies according to reflectivity, transparency, colour and the like, the method of producing the gating signal preferably includes at least one thresholding step so that a sharp silhouette of the foreground content can be obtained and the

otherwise analogue signal converted into a true binary signal.

In the case of a photobooth or studio situation, the second picture signal may comprise for example the head and shoulders of a person to be photographed. This can be processed to form a gating signal which enables the digital data relating to the head and shoulders of the person concerned to be separated from the remainder of the data (the background) in the scanned image.

By adjusting the direction or position of the illumination, it is not necessary to use a different source of illumination or wavelength in order to produce a silhouette image of the subject. It is merely necessary to ensure that the background in front of which the subject is positioned is illuminated in such a way that the subject is silhouetted against the illuminated background, thereby enabling the gating signal to be generated corresponding to the pixels which relate to the silhouette.

According to a further aspect of the present invention, the source of illumination need not be changed in either direction, position or wavelength if data processing is provided so as to enhance the pixel content of the silhouette image. Also the foreground subject image content can be selected from the background image content on the basis of colour provided that the background colour is not present at any edge of the silhouette. The enhancement method thus entails analysing the silhouette content as compared with the background colour or colours and determining digital signals within the silhouette signal which differ from the background colours so as to

generate the gating signal pixels. Using look ahead techniques and suitable algorithms and thresholding techniques, it is possible to identify pixels having a background colour which are wholly surrounded by pixels which do not contain any background colour, and to disregard them as background and identify them as foreground image content.

Thus for example if a subject comprises a man whose shirt colour happens to correspond rather closely to a colour within the background, the shirt can be identified as belonging to the subject provided the shirt is wholly surrounded by pixels the colour or other parameter of which has no counterpart in the background. The pixel data corresponding to the "shirt" can then be modified so as to produce a colour which is quite distinct from the background so that when the pixel data relating to the complete field is subjected to a thresholding technique, the pixels relating to the head and shoulders of the subject will all have a colour or other parameter which is not present in the background.

According to another aspect of the invention, illumination for producing the gating signal may be derived from a small source positioned in such a way so that the subject in the foreground is illuminated to a considerably higher intentsity then in the background.

The data in the image will thus correspond to a brightly lit subject against a relatively dark background. As for the back lit case, the pixel intensity of the image gives directly a measure of the image transparency allowing the same benefits as above described.

This further aspect of the invention has the additional advantage of not requiring any special elements behind the subject, thus the imaging system could be wall mounted greatly reducing floor space requirements.

According to a further implementation the invention, at least a first picture signal is produced by scanning the field of view using appropriate illumination so as to obtain a silhouette of the subject relative to the background. Thus for example two silhouette images may be produced one in which the illumination is straight on and another in which the illumination is from the side so as to bring into relief by appropriate shadow and highlighting different features of the surface subject such as for example the chin of the head of someone whose head and shoulders is to be photographed. This second silhouette image may then be processed so as to locate the position of the particular feature or features of the subject identified by adjacent maximum and minimum regions of brightness or by using a neural network pattern recognition technique. Once the location of the known feature is identified, this positional information may be combined with other positional data of the subject found from the other silhouette gating signal, enabling the image to be resized and relocated accurately in relation to the identified feature.

This aspect of the invention is of particular application in the field of passport photography since it allows the chin position for example to be pre-selected and maintained and the remainder of the head scaled relative to the chin position so as to occupy the appropriate area on the photograph.

The invention also lies in apparatus for performing the above methods and techniques.

The invention also lies in photographic prints or transparencies produced using the gated image data.

The invention also lies in a method of producing photographs from image data relating to the pixels in the scanned image of the overall field of view albeit with the background modified as required and with image content relating to the foreground subject scaled if appropriate so as to be of a correct size and position in relation to the final photograph to be obtained.

The invention also resides in a photobooth in which a subject can stand or sit for self-take photographs comprising scanning and signal processing apparatus as aforesaid, means for illuminating the subject and the background from the front to enable a conventional scanned image of the subject and background to be obtained and means for differentially illuminating the background and subject to enable a picture signal to be obtained representative of a silhouette of the subject, and a gating signal to be derived therefrom; and gating means for selecting the image content relating to the subject from the first picture signal using the silhouette signal as a gating signal, and superimposing the selected subject picture content on a fresh background and means for printing a representation of the superimposed picture content and different background.

The printing process may comprise laser-jet, ink-jet, dot matrix, plotter or photographic process in which the picture signals are displayed on an appropriate CRT

display and conventional photographic film is exposed to the displayed image and subsequently processed.

The invention also lies in a photographic studio having selectable background media, adjustable and selectable lighting for illuminating the background and/or a subject placed in front of the background, imaging means and scanning means associated therewith for scanning an image of the subject and the background in quick succession when subjected to differential illumination so as to obtain a gating signal for separating picture signals relating to the subject from the picture signal relating to the background, to allow a picture signal relating to the subject to be superimposed on a different background and means for generating a composite picture signal relating thereto for subsequent processing to enable a print to be obtained therefrom.

The invention is not limited to the superimposition of the abstracted image content onto a plain background but additionally envisages within its scope in respect of each of the aspects of the invention herein described the super imposition of the abstracted subject image content onto a different background which may itself comprise a picture or scene of pattern.

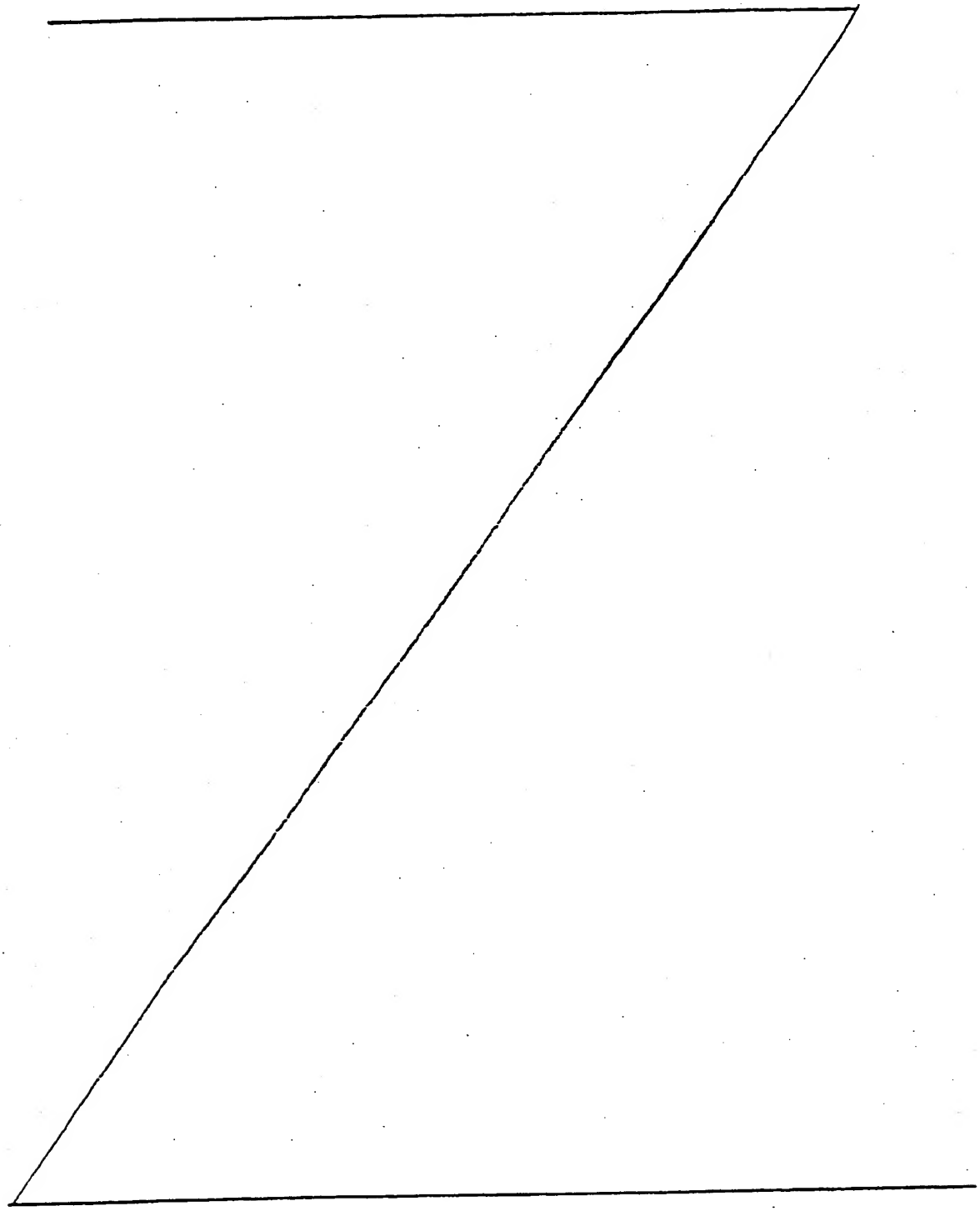
Also within the scope of the invention is the provision of buffer storage means for storing the abstracted video signal relating to two or more different subjects and means for mixing the video signals so as to enable the video signals of selected ones of the different subjects to be combined for superimposition or combination side by side or one above the other on one or more selected backgrounds.

So far the invention has been described primarily in relation to still subject matter. i.e. a motionless subject sitting in front of a motionless background. It is to be understood that the same technique may be employed for producing video signals relating to a moving subject relative to a stationary background or when both subject and background are moving relative to the viewing device. Whatever the scenario, it is merely necessary for each "take" of a sequence of pictures which are subsequently to be presented in rapid succession, to be illuminated twice, once "normally" and the other so as to differentially illuminate the foreground and background to enable a silhouette gating picture signal to be produced as aforesaid, one gating signal for each frame. By storing the different picture signals separately and synchronously reading out the signals and gating one signal relative to another before mixing, so the same effect as described in relation to a still picture can be obtained for each of the pictures which are to be presented in a moving sequence of pictures.

The resultant picture signals may be printed into a sequence of transparencies for projection in a conventional manner using a movie projector or may be presented to a CRT display for sequential display thereon in the manner of a television display and/or may be stored on a video tape or other data carrier for subsequent playback via a CRT display.

The invention lies in a method of producing a moving pictorial representation as aforesaid and in apparatus for performing the said method.

An alternative printer may be employed such as a dye diffusion thermal transfer printer, such as made by Tektronic Corporation and marketed under Phaser 480.



The invention will now be described by way of example with reference to the accompanying drawings in which:-

Figure 1 is a diagrammatic illustration of a photobooth for self-take photographs,

Figure 2 is a block schematic diagram on the control unit for a camera and illumination system for the photobooth of Figure 1,

Figure 3 illustrates the process which is followed through when a photograph is required,

Figures 4a and 4b show the primary and secondary images obtained using the process of Figure 4,

Figure 5 illustrates a wall mounted self-take photographic unit for producing photographs suitable for passports,

Figure 6 illustrates an alternative illumination arrangement and

Figure 7 illustrates the three pictures obtained using the system of Figure 5 with the illumination system of Figure 6.

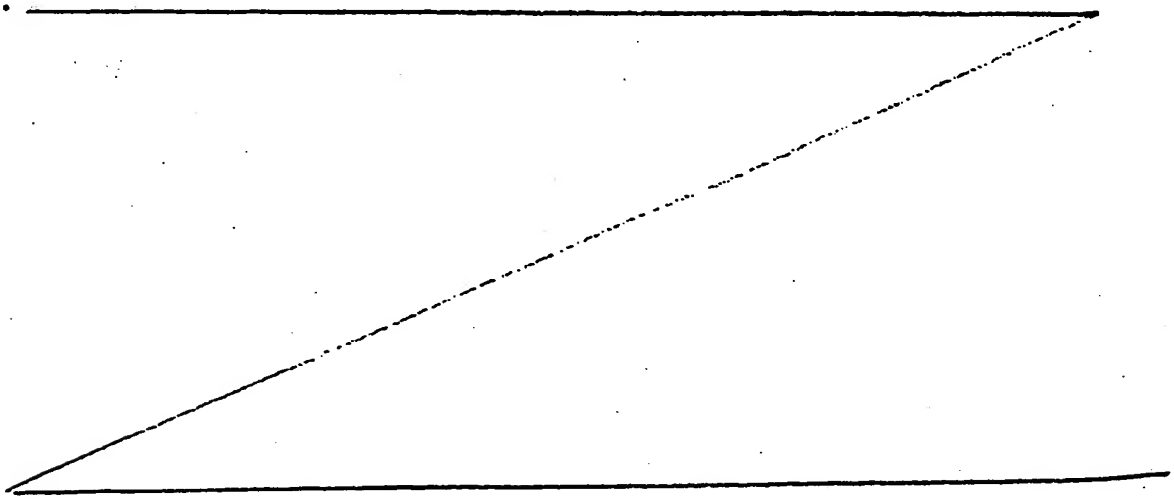


Figure 1 shows a photobooth 10 comprising a seat 12 on which a subject 14 can sit. A window 16 in a partition wall 18 enables the head and shoulders of the subject to be viewed by a camera shown diagrammatically at 20 mounted above a control unit 22 and connected thereto by cabling 24. A primary source of illumination is shown at 26 and a secondary illumination source is shown at 28.

Unlike conventional booths the booth shown in Figure 1 when operated in accordance with the present invention can produce images of customers with a substituted high quality background matched accurately to the boundaries of the subject.

Although shown in a seat the subject of course could stand within the booth but the seated position is preferred.

The primary illumination is provided by flashing a lamp 26 which illuminates both the subject and the background.

A flash-type of illumination is also used for the secondary illumination at 28 and typically this comprises a diffusive panel behind the subject through an infrared filter which does not transmit the visible component of the spectral output of the flash.

It is of course important that the camera 20 is able to detect infrared light as well as visible light. If an infrared filter is fitted, this must of course be removed from the camera.

The camera 20 operates in a frame integration mode that is a single exposure is used to capture both the odd and even fields of each video frame. The camera outputs both a

video signal, from which sync pulses are extracted to control the flash timing, and RGB signals which are fed into a frame grabber. The frame grabber is capable of capturing one colour image at the full PAL resolution of 768 x 512 pixels with 24 bits per pixel and another monochrom image of the same resolution with 8 bits per pixel from each successive video frames.

The signal processing and camera control circuits are shown in Figure 2. Thus camera 20 RGB signals are shown passing to the frame grabber designated 30 and the digital data from the frame grabber is processed via an image processing unit 32 located in the control unit 22 and when required can be outputted to a print engine 34 such as a video to photographic film converter.

The control unit essentially comprises a micro-computer programmed to produce control signals and timing signals along the dotted line to and from the camera frame grabber and flash sources 26 and 28. The sync pulses from the camera 20 are shown directed to the flash sources although it may be preferred that the sync signals are provided to the control unit 22 to proceed via that unit to control the synchronous flashing of the two illumination sources.

The micro-computer is also programmed to provide whatever image processing and enhancement functions are desired to enable the booths print engine to operate. Control signals are also derived from the micro-computer/control unit to control the operation of the print engine 34.

The basic operation of the control booth is shown in Figure 3.

When the image acquisition sequence is initiated, the primary illumination flashes on the next sync pulse for an odd video field. The frame grabber captures this video frame when it is read out from the camera.

The secondary illumination flashes triggered by the next sync pulse. This flash is not seen by the subject because of the infrared filter which cuts out the visible component of the flash. The secondary image is captured by the frame grabber in monochrom.

The form of the primary and secondary images is illustrated in Figures 4a and 4b. The primary image contains a full colour high resolution portrait of the subject and the secondary image is a monochrom silhouette of the subject in the form of a binary signal which can be used to gate out the image content relating to the subject from the background. In fact the brightness of the secondary image gives a direct measure of the transparency of the subject and a pixel-by-pixel basis.

When both images have been captured the image processing function is performed. The primary image is adjusted for colour balance, brightness and contrast using look-up table conversions (LUT conversions), where each pixel value is replaced by another pixel value if require. The primary image is then combined with a stored background image by averaging the pixel values from the primary image with those from the background image using the secondary image pixel values as weights, creating a high quality composite image. Further image enhancement might involve superimposing other images or text onto the composite image.

In another embodiment of the invention the camera frame grabber control an illumination system is mounted on a wall at about face height as shown in Figure 5. The same reference numerals are used to denote the same items as are employed in the photobooth of Figure 1 with the exception of the secondary illumination which is denoted by reference numeral 29 instead of 28.

In addition to requiring very little space, the system shown in Figure 5 is capable of determining the size of the subjects head and re-scaling the image to meet the image size requirement of a passport photograph.

As before both primary and secondary illuminations are achieved by using flash illumination, but in order to provide a second secondary image, additional visible light illumination sources are provided 36 and 38 on the right and lefthand side of the camera and the normal secondary illumination source is denoted by reference numeral 40 and comprises a small infrared source close to the camera.

Figure 6 shows the arrangement best from above. The resulting images are illustrated at Figures 7a, 7b and 7c.

That in Figure 7a is the one which is obtained by using the primary illuminations source shown in Figure 5 at 26 and 29. No vertical shadows were produced since the two light sources 26 and 29 respectively illuminate shadowed regions created by the other. The first secondary image using the infrared source 40 produces a silhouette image shown in Figure 7b.

The second secondary illumination produces a dark shadow

under the subjects chin since the two light sources of Figure 6, 36 and 38 are above the level of the subjects head and there is no compensating illumination from a source such as 29. This is shown in Figure 7c and the dark region immediately below the subjects chin can be used to locate this particular region of the image during subsequent image processing.

An additional difference from the previous embodiment is that the camera now has a limited exposure (integration) time, and the flashes are synchronised to this period by delaying the trigger pulse for a short period after the video sync pulse. This has the benefit of increasing the rejection of ambient lighting over which there is now no control.

The background of the primary image is subsituted as before by mixing the primary image with a stored or generated background using the pixel values of the silhouette images weights.

The top of the subject's head is found by examining the silhouette image. The top of the head may be defined as the first row of pixels, starting from the top of the image, that contains more than say 2% bright pixels. The width of the head is easily found from the silhouette image by finding the maximum width of the bright region in the centre of the image below the top of the head.

The second signatory image is used to locate the subject's chin. Starting from the corners at the top and centre of the head, a search is made for the dark shadow cast under the chin by the illumination from 36 and 38. The top edge of this shadow represents the underside of the chin in the

image.

These procedures define a rectangle which fits around the of the subject in the image.

This rectangle can be mapped, (translated and scaled) onto a corresponding rectanle defined by the relevant passport authority so that the bit-mapped content therein can be displayed with a pixel spacing in both X and Y directions so as to just fill the passport authority defined rectangle so that whatever the size of the head as imaged during the scanning, the reproduction of the video signal will be to a scale which enables the head to just fill the rectangle laid down by the passport authority.

Claims:

1. A method of generating digital pixel data of a field of view containing foreground and background content so that the former can be separated from the latter, comprising:-

(a) scanning the field of view whilst subjecting the latter to normal illumination and storing the digitised data on a pixel-by-pixel basis as a first picture signal,

(b) illuminating the field of view so as to render the foreground distinguishable from the background and scanning the field of view and storing the digitised data so obtained on a pixel-by-pixel basis as a second picture signal,

(c) generating a binary gating signal from the dsecond picture signal wherein the pixels in the gating signal have one value if they relate to the foreground and a second value if they relate to the background, and

(d) processing the first picture signal using the binary gating signal so as to select the digital signals corresponding to the pixels which relate to the foreground content of the field of view from those relating to the background, to form a third picture signal.

2. A method as claimed in claim 1 in which the third signal (relating to the foreground) is combined with a picture signal corresponding to a different background from that of the original field of view.

3. A method as claimed in claim 2 wherein the different

background picture signal is of a single colour.

4. A method as claimed in any of claims 1 to 3 wherein the scanning to produce the gating signal is performed before the scanning to produce the first picture signal.

5. A method as claimed in any of claims 1 to 3 wherein the scanning to produce the gating signal is performed after the scanning which produces the first picture signal.

6. A method as claimed in either of claims 4 and 5 wherein both scans are undertaken in rapid succession so that any movement of the original field of view is effectively arrested so that image data obtained by the two scans remains substantially aligned.

7. A method as claimed in any of the preceding claims wherein the scanning device is responsive to visible light and infrared light and a source of infrared radiation is used to illuminate the field of view so as to produce the second picture signal.

8. A method as claimed in any of claims 1 to 7 wherein visible light is used to illuminate the foreground and background and during the scanning to produce the first picture signal at least the foreground is front lit and during the scanning to produce the second picture signal at least the foreground is back lit.

9. A method as claimed in any of claims 1 to 8 wherein flash illumination or pulsed illumination is employed during one or other or both of the scans.

10. A method as claimed in any of the preceding claims wherein the scanning device is rendered insensitive to light or other radiation except in synchronism with each of the flashes so that the effect of ambient light is reduced.

11. A method as claimed in claim 8 wherein the back lighting is achieved by an illuminated diffusive panel in front of which a subject constituting the foreground is placed, so that the background image is captured during the scanning to produce the gating signal which is a direct measure of the transparency of the foreground material.

12. A method as claimed in any of the preceding claims wherein a gating signal is derived from the second picture signal using at least one thresholding step so that a picture signal of a sharp silhouette of the foreground content is obtained.

13. A method as claimed in any of the preceding claims further comprising the step of comparing the colours of the pixels in the third picture signal with the colours present in the background of the first picture signal and changing the colour of any pixels in the foreground picture signal content to a colour different from any colour present in the background of the first picture signal.

14. A method as claimed in any of the preceding claims wherein the second picture signal is obtained by illuminating the foreground to a much greater intensity than the background so that the pixels relating to the foreground can be distinguished from the pixels relating

to the background on the basis of brightness.

15. A method as claimed in any of the preceding claims in which at least a fourth picture signal is produced by scanning the field of view using a source of illumination from the side or below or above so as to bring into relief and create a dark shadow of at least one selected feature of the foreground subject so that the position of the feature thrown into relief in the fourth picture signal because of the shadow can be readily distinguished by thresholding within the fourth picture signal to permit positional information to be derived of the feature or features within the first picture signal.

16. A method as claimed in claim 15 wherein the positional information obtained from the fourth picture signal is combined with the gating signal during processing of the first picture signal so as to enable scaling and positioning of the foreground content of the first picture signal in a fifth picture signal.

17. A method as claimed in any of the preceding claims wherein the finally processed signal is stored and/or processed so as to produce a print such as a photographic print of the selected foreground against a selected background.

18. Apparatus for performing the method of any one of claims 1 to 16.

19. Photographic prints or transparancies produced using the method of any one of claims 1 to 16 or the apparatus for claim 17.

20. A photobooth in which a subject can stand or sit for self-take photographs comprising scanning and signalling processing apparatus as claimed in claim 17, means for illuminating the subject and the background from the front to enable a conventional scanned image of the subject and background to be obtained and means for differentially illuminating the background and subject to enable an image signal to be obtained representative of a silhouette of the subject so that a gating signal can be derived therefrom, and gating means for selecting the image content relating to the subject from the first picture signal using the silhouette signal as a gating signal, superimposing the selected subject picture content on a fresh background picture signal, and means for printing a representation of the superimposed picture content and different background as a final print.

21. A photobooth as claimed in claim 19 in which the printing process comprises a laser jet printer, ink jet printer, dot matrix printer, plotter, dye diffusion thermal transfer printer or a photographic processor.

22. Apparatus as claimed in claim 20 wherein the picture signals are displayed by means of a CRT display or the like and conventional photographic film is exposed to the displayed image and subsequently processed to produce a photograph thereof.

23. A photographic studio having selectable background media, adjustable and selectable lighting for illuminating the background and/or a subject placed in front thereof, imaging means and scanning means associated therewith for scanning an image of the subject and the background in quick succession when subjected to differential

illumination, so as to obtain a gating signal for separating picture signals relating to the subject from picture signals relating to the background, to allow a picture signal relating only to the subject to be produced for combining with a different background picture signal, so that when displayed the subject appears superimposed on the different background, and means for generating a composite picture signal relating thereto for subsequent processing to enable a print to be obtained therefrom.

24. A method as claimed in any of claims 1 to 16 wherein the combination of the picture signal relating to the foreground includes the combination of that selected picture signal content with another similarly selected picture signal content of other foreground material from other scannings and the super imposition of two or more such foreground picture signals on a background picture signal to produce a composite final picture signal.

25. Apparatus for performing the method of claim 4 which includes buffer storage means for storing the abstracted picture signals relating to two or more different subjects and means for mixing the picture signals so as to enable the picture signals of selected ones of the different subjects to be combined for superimposition or in combination side-by-side, or one above the other against one or more selected backgrounds.

26. A method as claimed in any of claims 1 to 16 wherein each take of a sequence of pictures which are to be presented in rapid succession to form a moving picture, is illuminated twice, once normally and the other so as to differentially illuminate the foreground and background in the field of view thereby to enable a silhouette gating signal to be produced as aforesaid, one gating signal for

each take, storage means is provided for storing the different picture signals separately and means is provided for synchronously reading out the signals and the gating signals before combining the signals so as to abstract from each signal the foreground content relating to each take and a final signal is produced by combining the abstracted foreground picture signal content with a desired background signal for the final moving picture signal to be displayed or printed.

27. A method as claimed in claim 25 wherein the sequence of takes are printed in the form of a sequence of transparancies for projection in a conventional manner using a movie projector.

28. A method as claimed in claim 25 wherein the final signal is read out as a real time video signal for display on a CRT display such as a television monitor.

29. Methods and apparatus for imaging enhancement constructed and arranged and adapted to operate substantially as herein described with reference to and as illustrated in Figures 1 to 7 of the accompanying drawings.

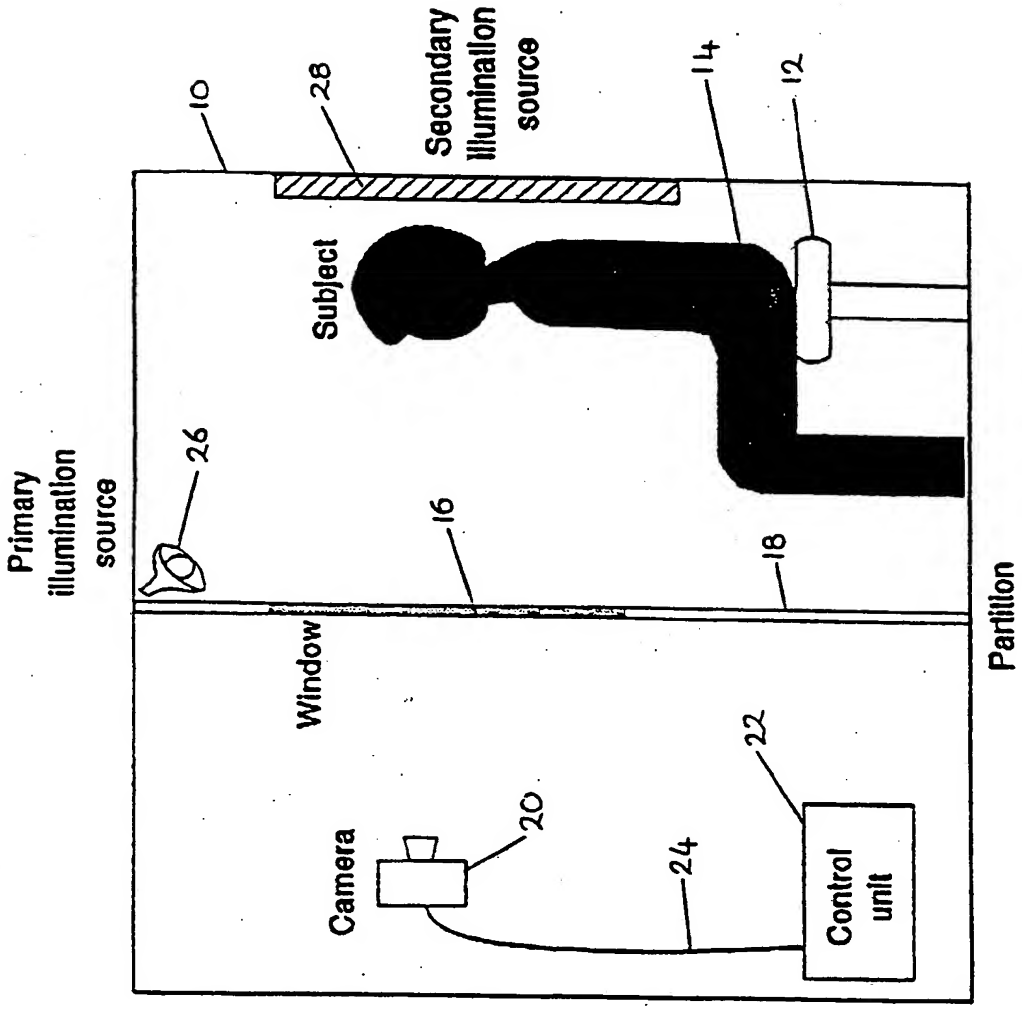


Figure 1

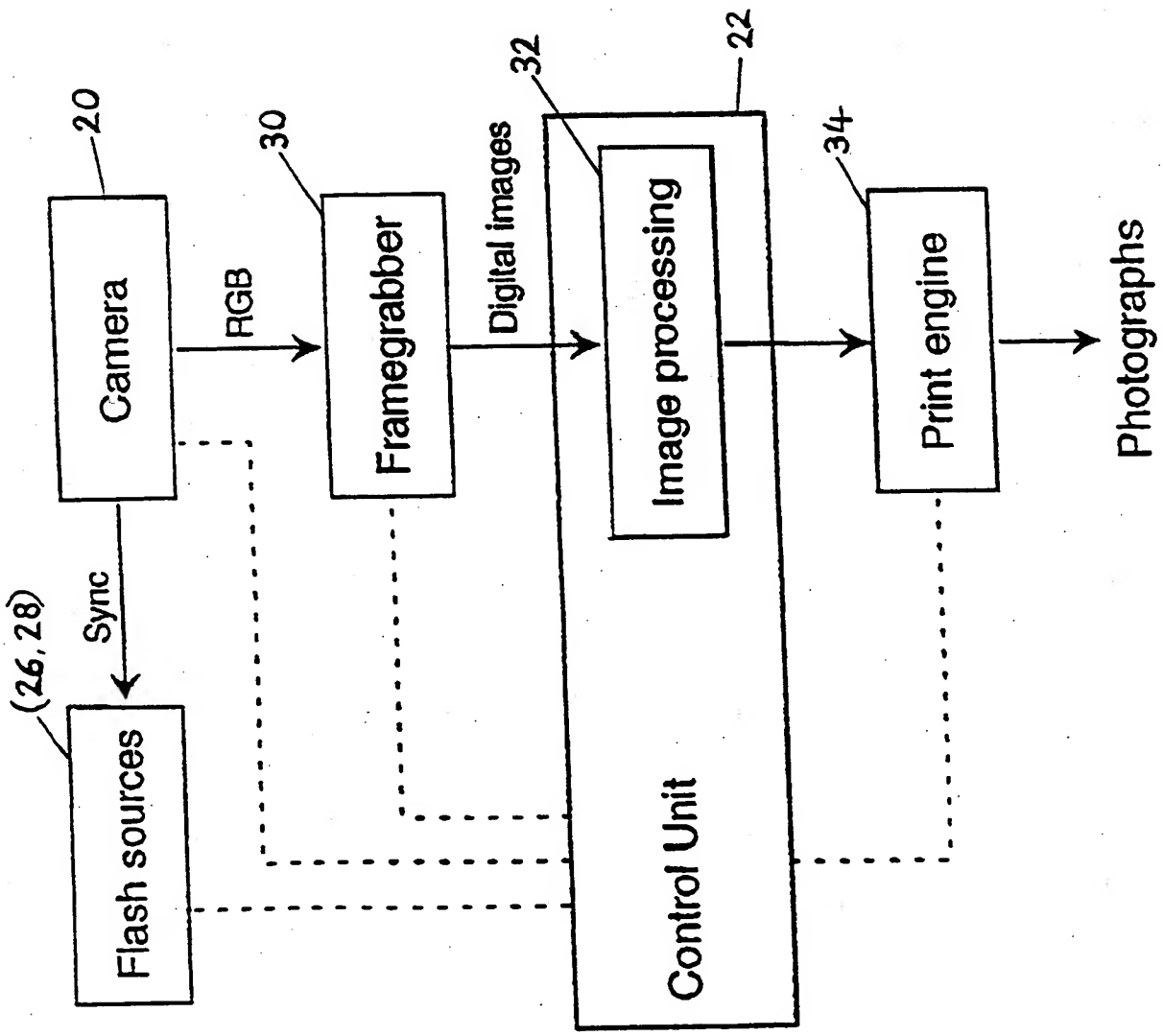


Figure 2

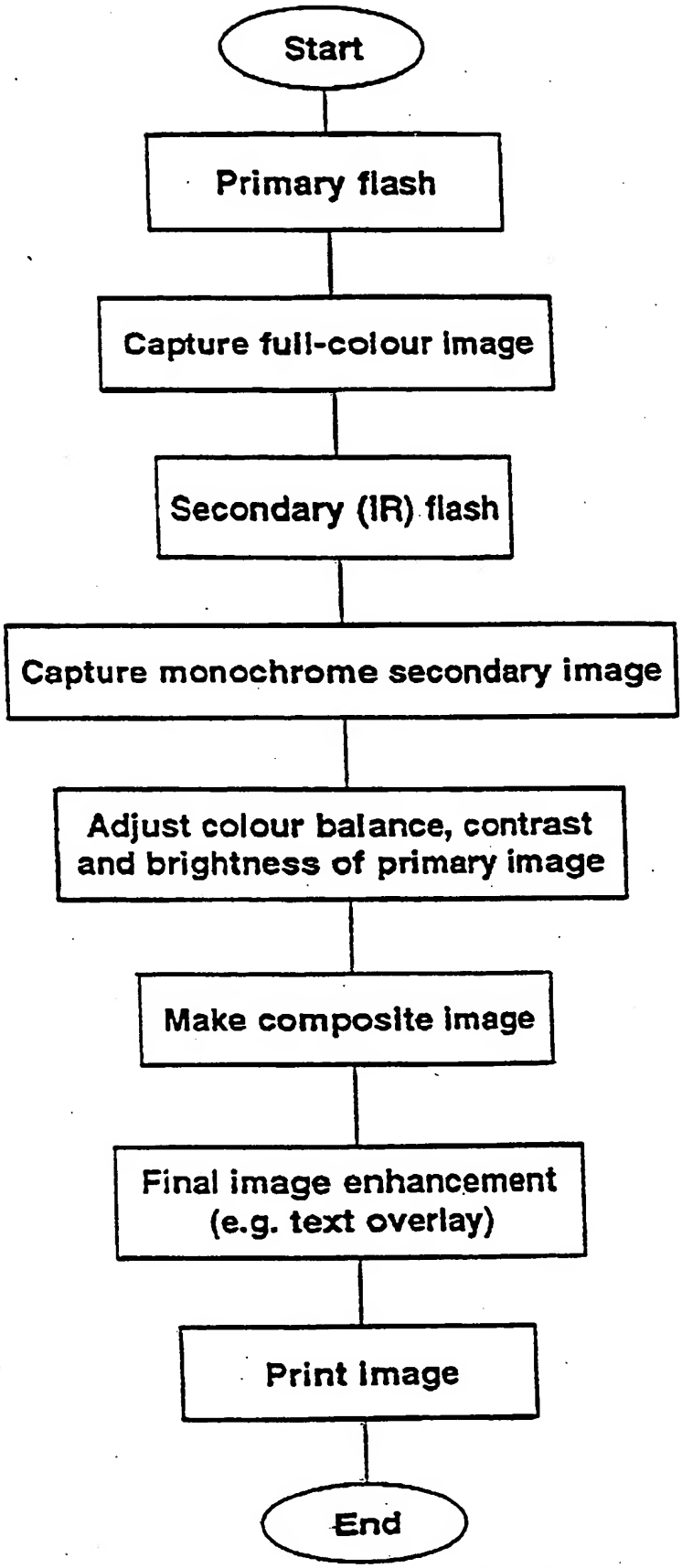


Figure 3

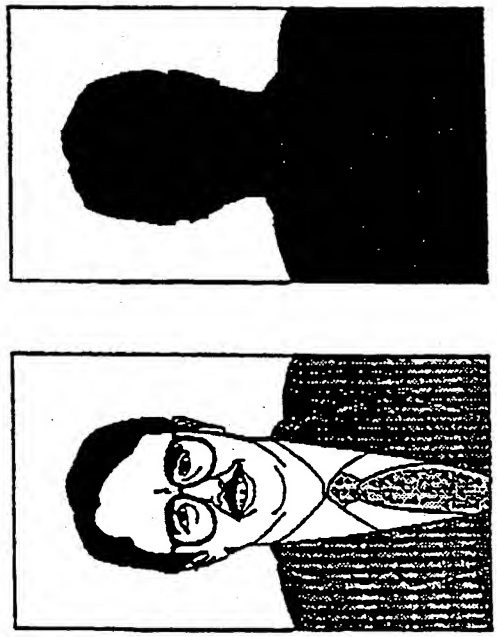


Figure 4

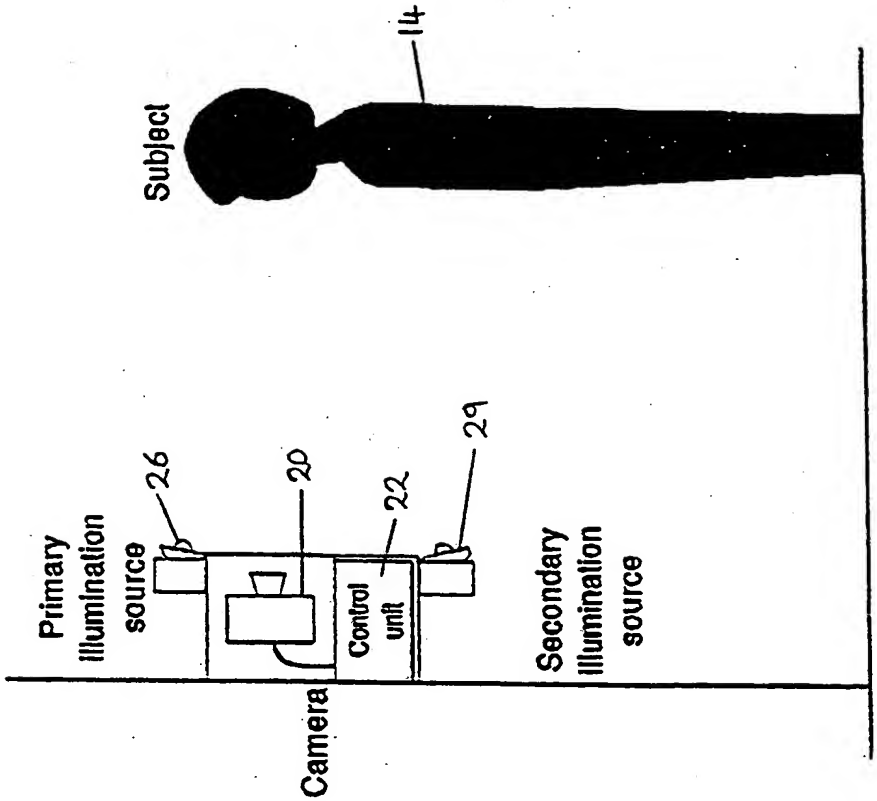
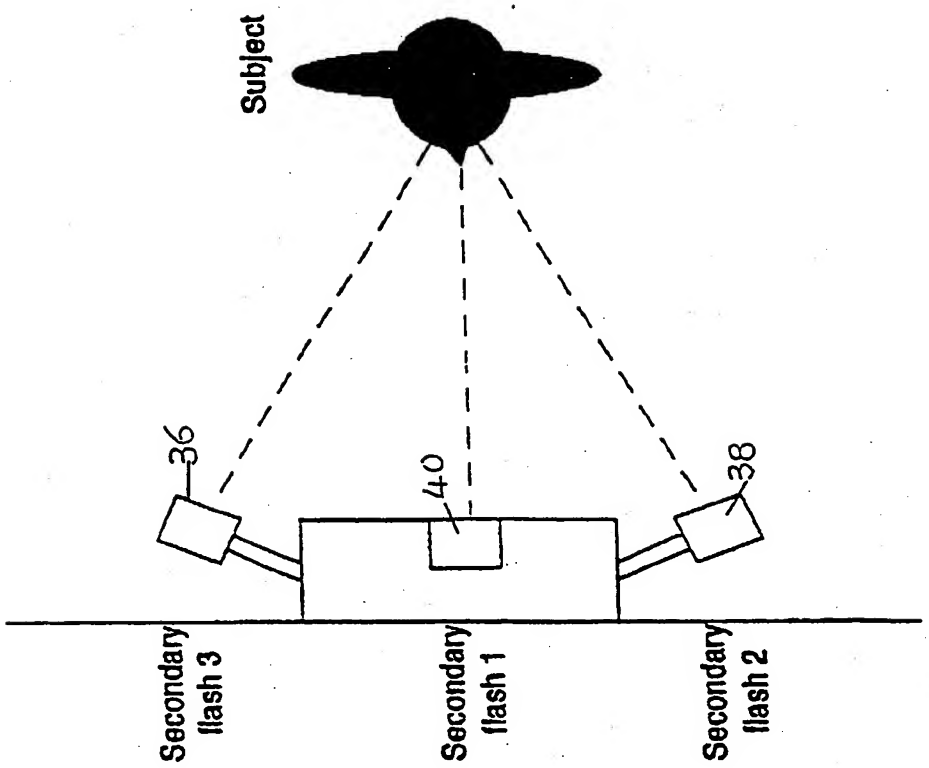


Figure 5

Figure 6



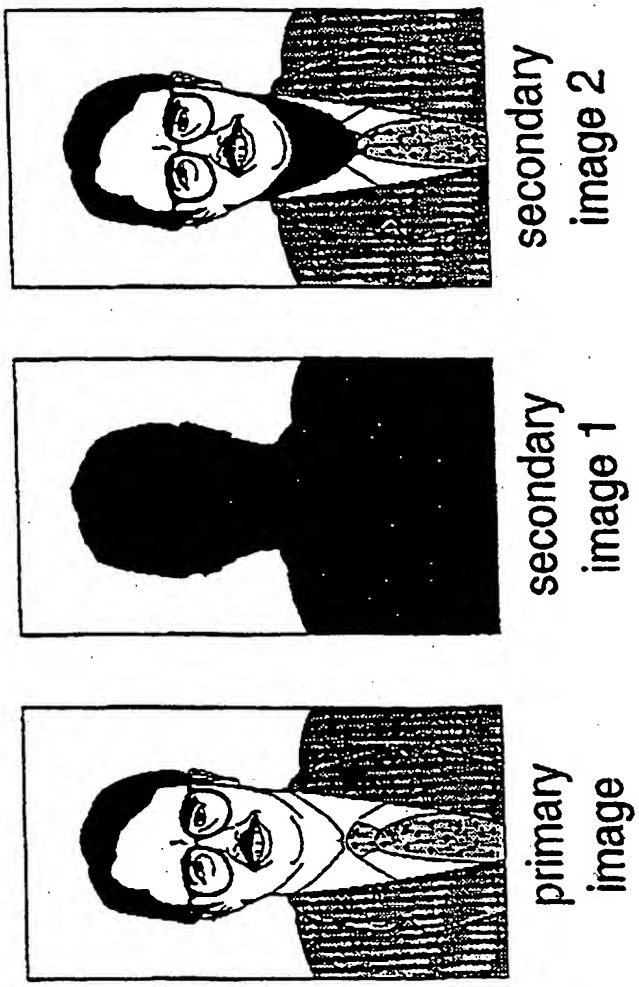


Figure 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/GB 94/00917

A. CLASSIFICATION OF SUBJECT MATTER
IPC 5 H04N1/00 H04N5/272 G03B17/53

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 5 H04N G03B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US,A,5 117 283 (KROOS ET AL.) 26 May 1992 see column 1, line 45 - column 3, line 63	1,2,12, 17-20, 22,23,29
Y	---	3-8,21
Y	WO,A,90 10251 (BARCREST LIMITED) 7 September 1990 see page 1, line 24 - page 10, line 21	3,21
A	---	2,11,15, 17-20, 22,23,29
Y	GB,A,638 937 (CINEMA-TELEVISION LIMITED) 21 June 1950 see page 1, line 1 - page 2, line 68	4-8
A	---	1,18,23, 29
	-/--	

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
27 July 1994	08. 24

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+ 31-70) 340-2040, Tx. 31 651 epo nl, Fax (+ 31-70) 340-3016	De Dieuleveult, A

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/GB 94/00917

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	FR,A,1 064 950 (PYE LIMITED) 19 May 1954 see page 1, left column, line 1 - page 2, left column, line 6	1,18,23, 29
A	JOURNAL OF THE SMPTE, vol.78, October 1969 pages 861 - 866 A. J. HENK 'A new approach to overlay in monochrome television' see page 862, right column, line 8 - page 863, right column, line 37	9,23,26, 28
A	US,A,5 109 281 (KOBORI ET AL.) 28 April 1992 see column 1, line 37 - line 62	24,25

1

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INTERNATIONAL SEARCH REPORT

information on patent family members

International application No.
PCT/GB 94/00917

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
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		EP-A-	0461147	18-12-91
		GB-A,B	2253490	09-09-92
		JP-T-	4506264	29-10-92
GB-A-638937		DE-C-	872066	
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FR-A-1064950		BE-A-	514994	
		DE-C-	926371	
		GB-A-	720182	
		US-A-	2753395	
US-A-5109281	28-04-92	JP-A-	63290754	28-11-88
		JP-A-	1027951	30-01-89